Stanford University

Econ 155: Environmental and Natural Resource Economics

Midterm

May 4, 2000

Directions (please read): You have 110 minutes to complete this midterm. This is a closed book exam although you may consult one double-sided sheet of notes. No other assistance is permitted. Put all of your answers in your exam book. The exam consists of three pages.

Part I. (3 points each)

Answer each question True (T) or False (F) and include a short (a sentence or two) rationale for your answer. Long-winded answers will be penalized.

1. Environmental values based on animal rights (ie, individual animals have intrinsic value), can be inconsistent with values associated with ecosystem sustainability.

Use the figure at right to answer questions 2-3. The figure depicts attainable utility levels for two individuals.

2. Point B is Pareto preferred to point A.

3. Point C is clearly and unquestionably a potential Pareto improvement over point A. [Hint: Suppose Bill is Bill Gates and Bob is the guy in the room next to yours]

4. Define an oligarchy as a specific subgroup of society smaller than the whole but containing at least two people. Let social choice for our society be equivalent to unanimous choices by the oligarchy. That is, for any two allocations, x and y: x is socially preferred to y if and only if the oligarchy unanimously prefers x to y. This social choice mechanism violates Arrow's axiom of completeness.

5. Suppose we have an economy of two people who are engaged only in exchange of two private goods. There is a fixed quantity of those goods and there is no production. Efficiency in exchange requires that the marginal rate of transformation between the two goods be equal to the marginal rate of substitution between those same goods.

6. The first theorem of welfare economics states that welfare programs such as food stamps are always Pareto improving.

7. If a good is nonexcludable, it will always (for all time) be nonexcludable.

8. Aggregate demand for a nonrival good is obtained by vertically summing individual demands.

9. When air pollution regulations result in increased expenditures on pollution control equipment, this is an example of a pecuniary externality.

10. The Coase Theorem states that the initial allocation of property rights does not matter in attaining efficiency, even in the presence of bargaining costs.

11. A Pigovian fee involves a charge per unit of pollution, paid by polluters, equal to the aggregate marginal damage from the pollution at the efficient level of pollution.

12. The equimarginal principle for homogenous pollutants holds that the marginal cost of pollution control for at least one polluter should be equal to the marginal damage of pollution.

13. Although a pollution control subsidy may send the same marginal signals as a pollution fee, a subsidy tends to result in too much of a pollution-intensive good being produced in the long run.

14. The theory of environmental regulation that involves endogenous politics is an example of a positive theory of regulation.

15. In using a market to control access to a nonrival but excludable public good, efficiency in consumption requires that the price be zero.

16. One of the main problems with command and control regulation is a failure of the equimarginal principle.

17. In the case of an externality, victims should always be compensated in order to attain efficiency.

18. With a dominant firm in a market for pollution permits, it does not matter (for efficiency) how permits are initially distributed.

19. In the paper by Fullerton and Stavins, the "Myth of Market Solutions" refers to the myth that economists always recommend a market solution to environmental problems.

20. In his paper in the readings, Robert Solow defines sustainable practices as those that allow the next generation to be as well off as the previous generation.

Part II (20 points each). Show all your work.

21. Gladys lives next door to Riley. Riley has nine bottles of Merlot (wine) and one kilo of Roquefort cheese; Gladys has 4 kilos of cheese and one bottle of wine. Both Gladys and Riley like wine and cheese. Unfortunately, when Gladys drinks wine, she becomes somewhat rowdy which upsets Riley. Riley's utility is given by $U_R = (W_R - W_G)C_R$ and Gladys' utility is given by $U_G = W_G C_G$, where W_R and W_G are the amounts of wine Riley and Gladys consume (respectively) and C_G and C_R are the amounts of cheese the two consume. Assume that our two citizens must get by with only wine and cheese, only engaging in exchange.

(a) What is the marginal rate of substitution between wine and cheese for our two individuals, only taking into account own consumption?

(b) What is the marginal rate of substitution between wine and cheese for our two individuals, taking into account the fact that the total amount of wine is ten bottles (what Riley doesn't consume, Gladys does) and the total amount of cheese is five kilos? [Hint: write Riley's utility as a function of W_R and C_R only]

(c) Explain the differences and similarities in the answers in parts (a) and (b).

(d) Draw an Edgeworth Box showing the indifference curves (using the utility functions defined above) for Riley and Gladys at the initial endowment point.

(e) Shade the area of Pareto improvments relative to the initial endowment point.

(f) Is $(W_R,C_R,W_G,C_G) = (8,3,2,2)$ Pareto optimal? Why?

22. Consider the problem of regulating acid rain in the eastern US. Assume emissions are generated in the Midwest and the Northeast but acid rain damage only occurs in the Northeast. One million tons of emissions in the Midwest results in 1 micrograms per square meter of deposition; one million tons of emissions in the Northeast results in 2 micrograms per square meter of deposition. Damage (in millions of dollars per year) from deposition (d) is given by $D(d) = d^2/2$ where d is measured in micrograms per square meter of deposition. Prior to any imposition of emission controls, the Midwest was emitting only 3 million tons per year, whereas the Northeast was emitting 5 million tons per year. Pollution control costs in either region are given by $C(k) = k^2/2$ where k is the amount of emission reduction per year in a region, in millions of tons.

(a) Write total damages in terms of the amount emissions are reduced in each of the two regions.

(b) Write an expression for the total social costs, consisting of emission control costs and pollution damage. Write this expression in terms of the amount emissions are reduced in each of the two regions.

(c) Find the efficient amount of emissions reduction from each region.

(d) What emission fee, applied in each region, would support this efficient level of emissions?